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(54) Detent mechanism for rotatable arm

(57) A turnbutton for retaining food and beverage trolleys (21) in an aircraft galley, comprises an arm (7) rotatably mounted on a fixed spindle (1) with a detent comprising a blind hole (31) drilled into a low stress region of the arm from the spindle-facing surface (8) of the arm and containing a ball (14) urged by a spring (13) into one of two or more index grooves (5) in the spindle, thereby ensuring a constant tamper-proof spring force while avoiding food traps. The blind hole (31) may be inclined or parallel to the spindle (1).

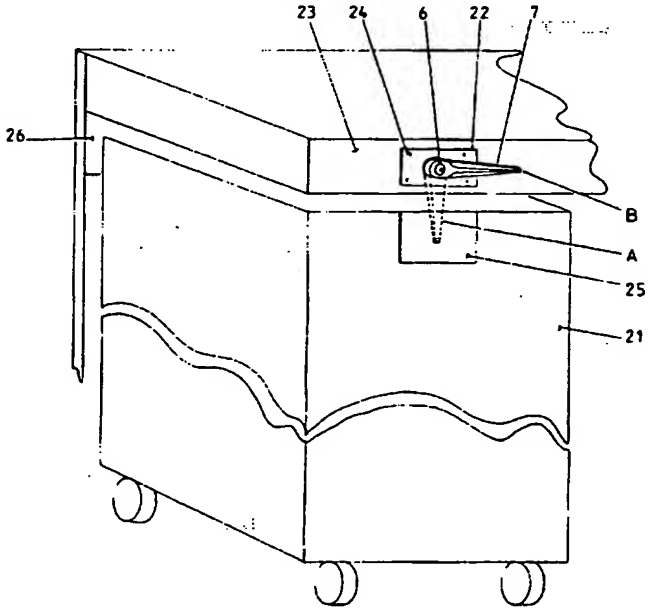

Fig. 3

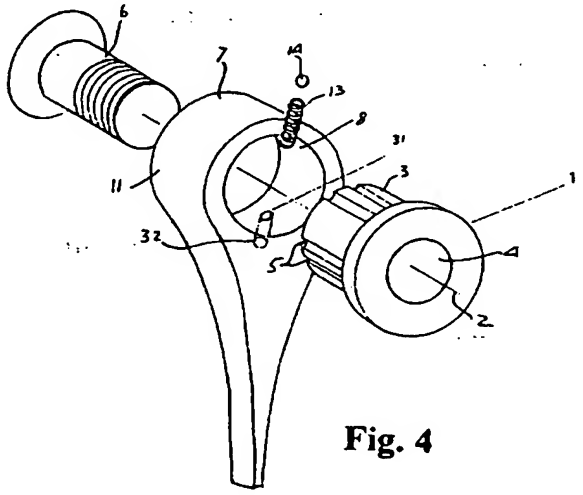

Fig. 4

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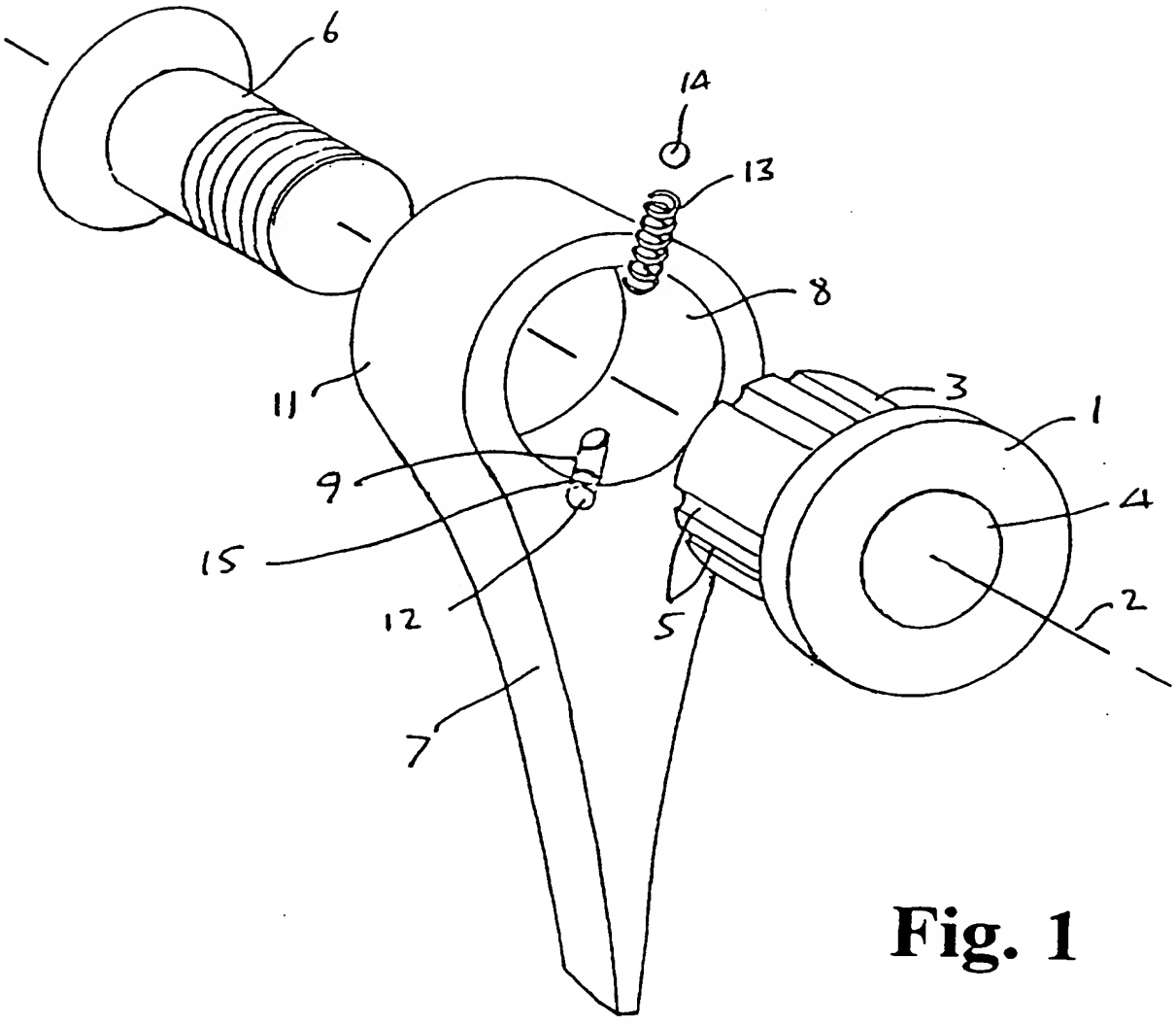

Fig. 1

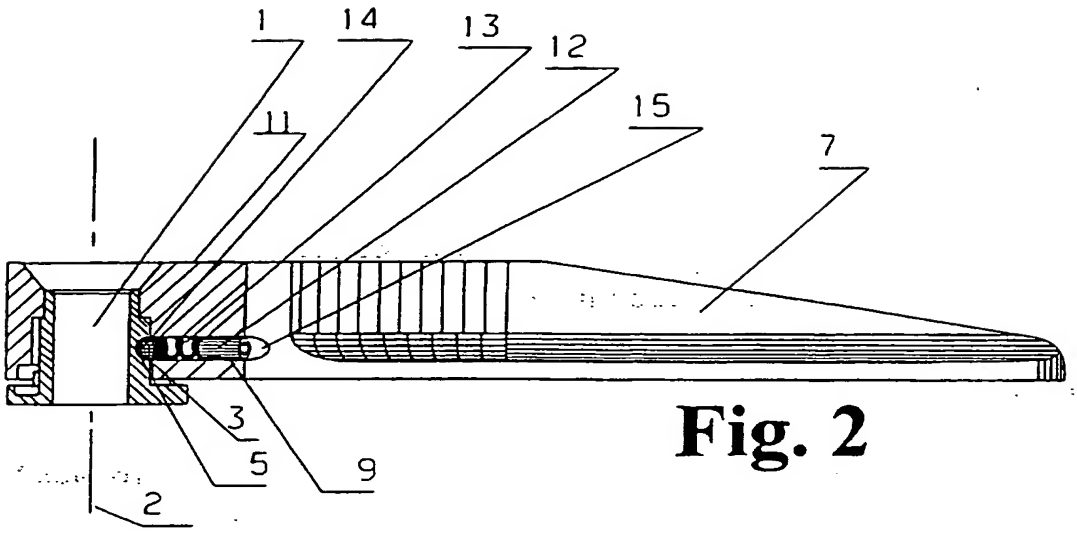

Fig. 2

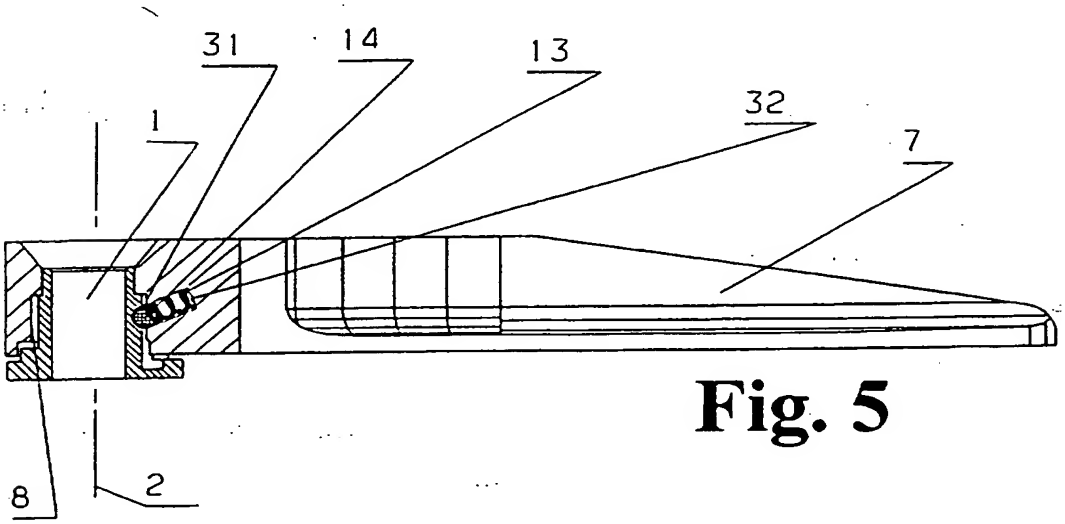

Fig. 5

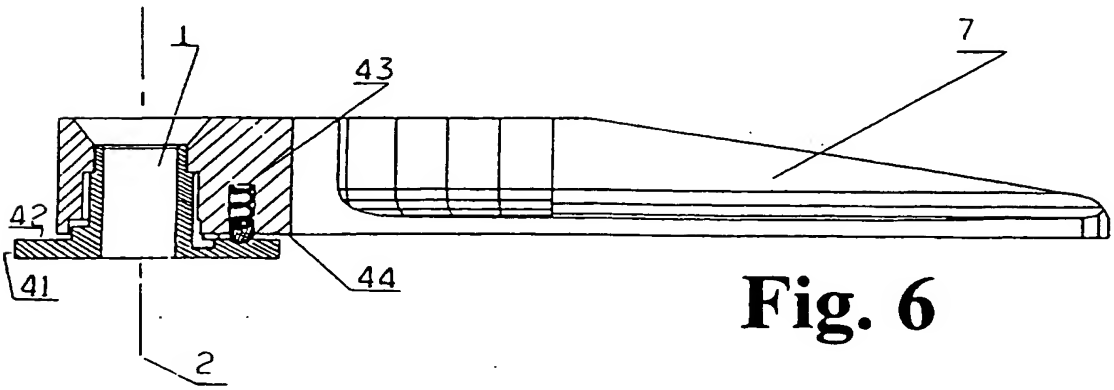

Fig. 6

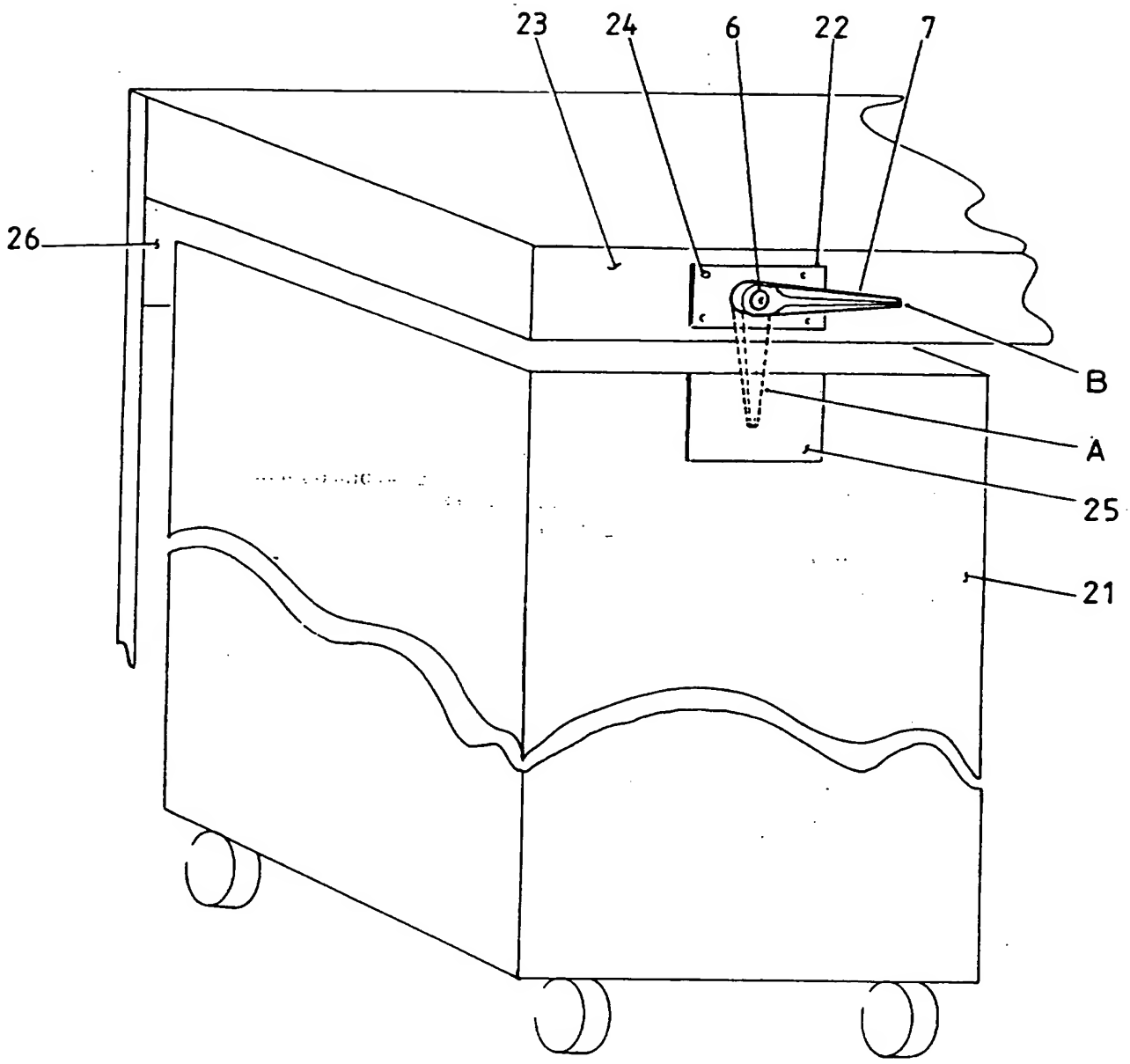

Fig. 3

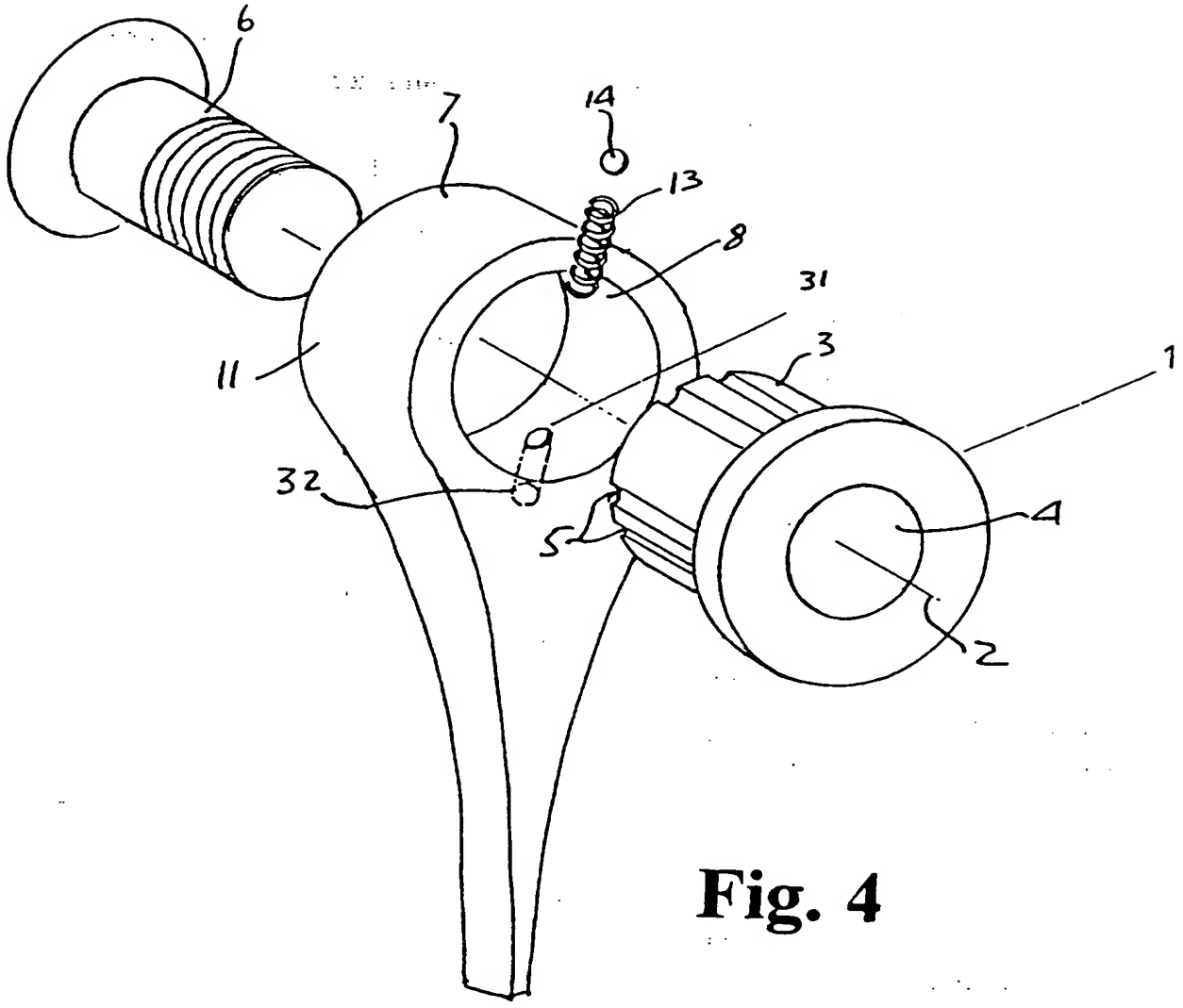

Fig. 4

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CATCH MECHANISM

The present invention relates to a catch mechanism for retaining a movable object in a required position. The invention has a particular application in retaining food and beverage trolleys used in aircraft in secure positions in the galley area. It is very important that catch mechanisms used to retain aircraft trolleys in position operate correctly and are strong since they have to withstand forces of up to 16G imposed by a trolley which might weigh perhaps 100 kilograms when empty and 150 kilograms when full.

The catch mechanism comprises an arm member which is rotatable about a fixed spindle. The arm member is movable between a "free" position in which it does not engage with the movable object and a "secure" position in which it engages with the movable object and prevents the movable object from moving out of a required position. The mechanism includes a detent which retains the arm in either the "free" position or the "secure" position.

When such a catch mechanism is used to retain food and beverage trolleys in aircraft in secure positions it is known as a turnbutton.

In known arrangements the detent of such a catch mechanism is formed by a spring loaded ball retained in a hole in the arm and engaging with grooves in the spindle about which the arm rotates. The inner end of the hole is positioned adjacent to the spindle and the outer end of the hole is open to the environment. The hole extends radially from the axis of the

spindle at right angles to the axis and is formed by drilling completely through the thickness of the material of the arm. The outer portion of the hole is threaded.

The catch mechanism including the detent is assembled by placing the arm on the spindle and securing the arm in this position so that it can rotate about the spindle. A ball is inserted into the outer end of the hole in the arm followed by a spring. The ball and spring are retained in position by a grub screw which engages with the thread in the hole. The force exerted on the ball by the spring can be adjusted by screwing the grub screw in or out so as to vary the length of the spring.

With such an arrangement the outer end of the hole is exposed to the environment. This end of the hole may pick up loose material. Also corrosion of the outer ends of the hole and the grub screw may occur, particularly if the materials of the arm and the grub screw are different or a light alloy plug is used to cover the end of the grub screw.

In the environment of an aircraft where the catch mechanism is used to retain food and beverage trolleys in secure positions in the galley area it is very likely that small particles of food will find their way into the outer end of the hole in the arm and will cause a health hazard and, possibly, increased corrosion. The galley area usually includes ovens and refrigeration units which cause the circulation of humid air and this can result in serious corrosion.

Further, since the outer end of the grub screw is permanently exposed, the grub screw can be adjusted at will. In the initial assembly of the catch mechanism the grub screw should be accurately adjusted by the skilled installer to the designed spring force, at which the arm is held in either of the two required positions firmly and without any play. After a

certain amount of use of the mechanism and exposure to vibration and a corrosive atmosphere the play in the arm may appear to increase leading to a perceived need for further adjustment of the grub screw by maintenance people who may be less skilled than the installer. This is likely to lead to over-tightening of the grub screw and the spring leading to premature failure of the spring, leading in turn to further over-tightening and eventually to permanent damage to the catch assembly.

The object of the present invention is to provide an improved catch mechanism of the above type.
The invention relates to a catch mechanism which includes an arm rotatable about a fixed spindle and a detent for retaining the arm in two or more positions relative to the spindle. The dimensions of the arm and the spindle are such that the arm fits closely on the spindle so as to allow rotation without any appreciable play.

The detent comprises a hole or passage extending into a portion of the arm which moves over a surface of the spindle. A ball and a spring are located in the hole. The spindle surface is formed with at least two spaced apart recesses. As the arm is rotated relative to the spindle, the ball, responding to a force exerted by the spring, will engage in one or other of the recesses. As a result, the arm can be retained in one or the other of two positions relative to the spindle.

In accordance with the invention the hole extends from a surface of the arm which is adjacent to the spindle but does not extend as far as any other surface of the arm. The hole is therefore blind. The force exerted on the ball by the spring depends on the dimensions and the material of the spring and of the depth of the hole. When the ball and spring have been assembled into the hole and the arm assembled onto the spindle, the force exerted on the ball cannot be changed. Further,

since the hole is blind and the space between the arm and the spindle is small so as to prevent any play, the likelihood of any gas or vapour or small particles entering into the hole in the arm and causing corrosion of the components of the detent is very small. Therefore the force exerted on the ball and the operation of the detent are not likely to be affected over a long period of time.

The spindle may have an outer cylindrical surface and the arm may be formed with an inner cylindrical surface adapted to move closely over the outer cylindrical surface of the spindle. With such an arrangement the hole to contain the ball and spring may be formed in the arm by drilling from the inner cylindrical surface on the arm and the recesses may be formed on the outer cylindrical surface of the spindle. The hole may extend radially of the common axis of the cylindrical surfaces at an angle with the axis other than a right angle.

In an alternative arrangement, the spindle may be formed with an outer cylindrical surface and with a radially extending flange including two or more recesses and the arm may be formed with an inner cylindrical surface adapted to engage with the outer cylindrical surface of the spindle and a radially extending surface adapted to move in rotation over the flange. With such an arrangement, the hole in the arm containing the ball and spring of the detent may extend from the radially extending surface of the arm in a direction parallel to the axis of the spindle so that the ball will engage in the recesses in the flange.

With arrangements in accordance with the invention in which the hole in the arm is blind, there is no need to form a thread in the hole and to use a grub screw engaging with such a thread to retain the ball and spring in position. The force exerted on the ball is preset by selecting the dimensions of the hole and the spring and the material of the spring, and this force

cannot be changed by inexperienced maintenance operations. By making the inner end of the hole flat or some other chosen shape the possibility of the spring being damaged is reduced. The assembly of the arm with the detent onto the spindle is simplified as compared with existing arrangements. There is no trap for food or other unwanted material in an open end of the hole or corresponding recess in the arm. There is no risk of damage to users by a possibly projecting grub screw.

A further advantage of arrangements in accordance with the invention is that the shape of the arm is not restricted by the need to provide access to the outer end of the hole containing the spring and the ball.

In order that the invention may be readily understood a known type of catch mechanism and a catch mechanism embodying the invention will both now be described with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a known type of catch mechanism with the components separated;
Figure 2 is a side elevation of the mechanism of Figure 1 sectioned along the axis of the spindle of the mechanism;

Figure 3 is a diagram showing how the mechanism of Figures 1 and 2 can be used to retain a movable object in a required position;

Figure 4 is a perspective view of a catch mechanism in accordance with the invention with the components separated;

Figure 5 is a side elevation of the mechanism of Figure 4 sectioned along the axis of the spindle of the mechanism; and

Figure 6 is a side elevation of an alternative catch mechanism in accordance with the invention.

With reference to Figures 1 and 2, the known type of catch mechanism includes a spindle 1 having an axis 2, an outer cylindrical surface 3 and an inner bore 4. Axially extending grooves 5 are formed in the outer cylindrical surface 3. The mechanism also includes a threaded bolt 6 which is adapted to pass through the threaded bore 4 and engage with a fixed anchorage.

The mechanism further includes a movable arm 7 formed with an inner cylindrical surface 8 adapted to engage with the outer cylindrical surface 3 of the spindle 1. In the portion of the arm 7 surrounding the surface 8 is formed a hole 9 which extends from the inner surface 8 to the outer surface 11 of the arm. The outer portion of the hole 9 is threaded at 12. A spring 13 and a ball 14 are adapted to be located in the hole 9 and a grub screw 15 is adapted to engage with the threaded portion 12 of the hole 9.

The catch mechanism is assembled by placing the inner cylindrical surface 8 of the arm 7 over the outer cylindrical surface 3 of the spindle and inserting the bolt 6 through the inner bore 4 of the spindle into a threaded anchorage (not shown). The bolt is tightened on the thread until the spindle is held fast against the anchorage. The dimensions of the components are chosen so that, when assembled in position, the arm 7 is free to rotate about the spindle 1 without any appreciable play.

The ball 14 is then inserted into the hole 9 followed by the spring 13 and these components are retained in the hole 9 by inserting the grub screw 15 in the threaded portion 12 of the hole 9. The ball 14 abuts against the cylindrical surface 2 of the spindle 1 and, depending on the rotational position of the arm 7 relative to spindle 1, the ball 14 will engage in one of the grooves 5 or with one of the portions of the surface 3 between the grooves 5.

The grub screw 15 is adjusted until the force exerted by the spring 13 on the ball 14 is such that, when the arm 7 is rotated to a position such that the ball 14 engages in one of the grooves 5, the arm 7 is firmly retained in this position and can only be moved out of this position by the use of a predetermined force on the free end of the arm. However, the precise design working length of the spring is extremely difficult for even the most skilled fitter to achieve without at any time overstressing the spring.

The combination of the ball 14, the spring 13 and the grooves 5 forms a detent.

As can be seen from Figure 2 the hole 9 extends radially relative to the axis of the inner surface 8 of the arm 7, which coincides with the axis 2 of the spindle 1, and at right angles to the axes.

Figure 3 shows how a catch mechanism as illustrated in Figures 1 and 2 can be used to retain a movable object 21 such as an aircraft food trolley in a required secure position. The spindle bolt 6 is mounted in an anchorage set into a fixed frame 23 behind a plate 22 which is attached to the fixed frame 23 by screws 24. The arm 7 extends over the frame 23. The movable object 21 can be moved into a secure position relative to the frame 23 such that a plate 25 on the object 21 is located adjacent to the spindle 1 and the arm 7. In this secure position the object 21 abuts against a portion 26 of the frame 23. In order to retain the object 21 in this position the arm 7 is rotated about the spindle 1 until it is in an operating position A in which it extends over the plate 25. The relative positions of the hole 9 in the arm 7 and the grooves 5 on the surface 2 of the spindle 1 are arranged so that, when the arm is in the operating position A, the ball 14 engages in one of the grooves 5 and the detent retains the arm in this operating position. The object 21 is retained in the

secure position by the object abutting against the portion 26 of the frame and the arm 7 abutting against the plate 25 on the object 21.

In order to allow the object 21 to be removed from this secure position, the arm 7 is rotated into a "free" position B in which it no longer engages with the plate 25. The arm 7 is retained in this "free" position by the detent causing the ball 14 to engage in another of the grooves 5 on the spindle 1.

As described above, the type of catch mechanism illustrated in Figures 1 and 2 suffers from several disadvantages. The outer end of the hole 9 is exposed to the environment and is therefore liable to corrosion and the trapping of small particles. The trapping of particles can be prevented to some extent by inserting a light alloy plug in the end of the hole outside the grub screw. However, this does not prevent the risk of corrosion. A further disadvantage is that the grub screw can work loose, and can be adjusted to take account of apparent wear in the spring. This may result in complete failure of the spring and unacceptable damage to the catch mechanism.

Figures 4 and 5 illustrate a catch mechanism in accordance with the invention. In these Figures the same reference numerals are used for components which have already appeared in Figures 1 and 2.

The main difference between the catch mechanisms described lies in the details of the hole in arm 7 to accommodate the spring 13 and the ball 14. In the embodiment illustrated in Figures 4 and 5 the hole 31 in the arm 7 extends from the inner cylindrical surface 8 but does not extend to the outer surface 11 of the arm 7. The hole 31 extends only partially within the arm and is therefore blind. It terminates in a flat end 32. Hole 31 extends generally radially of the common axis 2 of the

spindle 1 and inner surface 8 of arm 7 but does not extend at right angles to this axis. As illustrated in Figure 5 hole 31 extends at an angle of about 22° to a line extending at right angles to the axis. The direction of hole 31 is largely controlled by the diameter of inner surface 8 since the position of a drill forming the hole is limited by abutment of the drill against the opposite edge of inner surface 8.

Hole 31 contains only the spring 13 and the ball 14. The force exerted on the ball by the spring depends on the dimensions and material of the spring and the depth of the hole 32. The depth of the hole is critical to the correct operation and working life of the catch mechanism. In a practical embodiment it was found that with a hole depth of 0.34" the mechanism operated correctly whereas with a hole depth of 0.36" the mechanism allowed the arm 7 to rattle.

This is illustrated in Table 1, where springs of the same length were tested to failure over a number of cycles of operation in blind holes of different depths. The third column lists an equivalent time to failure, expressed in years, based on an aircraft galley turnbutton used six times per flight, for eight flights per day, three hundred and sixty days a year.

Table 1

Hole depth inches	Cycles to failure	Years to failure
0.28	90,000	5
0.30	80,784	5
0.32	65,594	4
0.34	253,572	15
0.36	1,395,000	81
0.38	749,394	43

It can be seen that 0.36" is the optimum depth in terms of life expectancy, but this is found to be too loose, allowing some play and rattle. A depth of 0.34" prevents rattle and gives a 15 year estimated life. The shorter depths illustrate the consequence of over-tightening.

In practice, over-tightening of the turnbuttons shown in Figures 1 and 2 is inevitable, and failures after as little as two or three months are common. Subsequent compensatory over-tightening of the fractured failed springs leads to gross mechanical damage and the need to replace the entire turnbutton mechanism at an early stage.

The shape of the inner end of the hole 31 is chosen so as to prevent the coils at the corresponding end of the spring being distorted during installation and operation of the catch mechanism. The inner end is described and illustrated as being flat and suitable drills to form this shape are available. However, other end shapes may prove to be more preferable.

To assemble the catch mechanism of Figures 4 and 5 first the spring 13 and ball 14 are inserted into the hole 31 and then the arm 7 is placed over the spindle 1. The catch mechanism then operates as illustrated in Figure 3 in the same way as the mechanism illustrated in Figures 1 and 2.

The hole 31 can be drilled sufficiently accurately using a numerically controlled drilling machine, but, as an alternative, it would be possible to use a guide in the form of a dummy spindle, with a flange to locate it correctly, containing a hole for the drill bit.

The hole 31 is preferably drilled in a low stress region of the arm 7, which is within 30° of the centre line of the arm as viewed in plan. The particular position chosen is designed to fit in with a selected design of spindle, irrespective of

whether the catch mechanism is designed to work with the arm 7 rotating through 90° (clockwise or anti-clockwise) or through 180° between the operating position A and the "free" position B.

The hole 31 is normally drilled from the underside of the arm 7 as illustrated in Figure 5 since this provides for the sh llowest angle but it could be drilled from the upper side. In theory the longer (deeper) the hole the better since this allows a longer spring to be used and this has a longer life. However, long holes are difficult to drill accurately.

The catch mechanism illustrated in Figures 4 and 5 has all the advantages described above in connection with a mechanism in accordance with the invention.

An alternative catch mechanism in accordance with the invention is illustrated in Figure 6. In this, the spindle 1 is formed with a flange 41 having a radially extending surface 42 and a blind hole 43 is drilled from the surface 44 of the arm 7 which abuts against the radially extending surface 42. The blind hole 43 contains the spring 13 and the ball 14. The radially extending surface 42 is formed with grooves in which the ball 14 engages to form the detent mechanism. This catch mechanism operates in the same way as the mechanism illustrated in Figures 4 and 5 and has the same advantages over the catch mechanism illustrated in Figures 1 and 2.

The catch mechanisms illustrated in Figures 4 and 5 and in Figure 6 have only one blind hole in the arm 7. Alternatively there could be more than one such blind hole.

Also in the catch mechanisms illustrated the rotatable arm member comprises only one arm 7. As an alternative there could be more than one such arm on the rotatable arm member.

The use of catches in accordance with the inventions for turnbuttons in aircraft galleys eliminates the rows of grub screw holes from the arrays of turnbuttons used to secure a large number of drawers, doors and trolleys, with consequent improvements in aesthetic appearance and hygiene as well as in component maintenance and replacement costs.

CLAIMS

1 A turnbutton for use as a catch mechanism for food and beverage trolleys in aircraft comprising an arm fitting closely and rotatably on a fixed spindle and a detent for retaining the arm in at least two rotationally spaced apart positions relative to the spindle, wherein the detent comprises a pa age, opening on to the said spindle surface, that extends into a portion of the arm from an arm surface which moves over a surface of the spindle but does not extend to any other surface of the arm, at least two rotationally spaced apart recesses formed in the said spindle surface, ball means confined in the passage, and spring means for urging the ball means towards the said spindle surface whereby to engage in a said recess when the arm is turned to a corresponding rotational position.

2 A turnbutton according to claim 1 wherein the spindle has an outer cylindrical surface and the arm is formed with an inner cylindrical surface adapted to move closely over the outer cylindrical surface of the spindle.

3 A turnbutton according to claim 2 wherein the recesses are formed on the outer cylindrical surface of the spindle.

4 A turnbutton according to claim 3 wherein the passage extends radially of the common axis of the cylindrical surfaces at an angle with the axis other than a right angle.

5 A turnbutton according to claim 4 wherein the passage extends at an angle of about 22° to a line extending at right angles to the axis.

6 A turnbutton according to claim 2 wherein the spindle is formed with an outer cylindrical surface and with a radially extending flange including at least two recesses and the arm is

formed with an inner cylindrical surface adapted to engage with the outer cylindrical surface of the spindle and a radially extending surface adapted to move in rotation over the flange, and the passage extends from the radially extending surface of the arm in a direction parallel to the axis of the spindle so that the ball means may engage in the recesses in the flange.

7 A turnbutton according to any one of the preceding claims wherein the passage is drilled in a low stress region of the arm within 30° of the centre line of the arm as viewed in plan.

8 A turnbutton according to any one of the preceding claims wherein the spring means comprises a coil spring and the blind inner end of the hole is flat.

9 A turnbutton according to any one of the preceding claims substantially as hereinbefore described with reference to, and as illustrated in, Figures 3 and 4, or Figure 5, of the accompanying drawings.

10 A retaining mechanism for a food or beverage trolley in an aircraft comprising a turnbutton according to any one of the preceding claims wherein the spindle is mounted in an anchorage set into a fixed frame in the aircraft and the arm extends over the frame, and the frame includes a portion against which a said trolley can abut, in which position of the trolley the arm is rotatable about the spindle between an operating position in which it extends over the trolley to retain the trolley between the frame and the arm, and the ball means engages in one of the grooves and the detent retains the arm, and a free position in which the ball means engages in another of the grooves and the trolley may be removed.

The Patent Office

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Application No:	GB 9522252.7	**Examiner:**	Peter Weller
Claims searched:	1 - 10	**Date of search:**	22 January 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): E2A ACCC ACME AARM AARS

Int Cl (Ed.6): E05C 3/04 3/14

Other: NONE

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2088467 A WILKES	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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